16

A Case of Gunshot Wound of the Brain in Which the Roentgen Rays Showed the Presence of Eight Fragments of the Bullet.

Localization by Sweet's Method Made Operation Inadvisable. With a Description of an Improved Apparatus for Localization of Foreign Bodies.

BY

W. W. KEEN, M.D.,

AND

WM. M. SWEET, M.D.,

OF PHILADELPHIA.

FROM

THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES,

JULY, 1903.

Extracted from The American Journal of the Medical Sciences, July, 1903.

A CASE OF GUNSHOT WOUND OF THE BRAIN IN WHICH THE ROENTGEN RAYS SHOWED THE PRESENCE OF EIGHT FRAGMENTS OF THE BULLET; LOCALIZATION BY SWEET'S METHOD MADE OPERATION INADVISABLE.

WITH A DESCRIPTION OF AN IMPROVED APPARATUS FOR LOCALIZATION OF FOREIGN BODIES.

By W. W. Keen, M.D.,

AND

Wm. M. Sweet, M.D.,

OF PHILADELPHIA.

DR. KEEN'S REPORT OF THE CASE.

The following case is put on record as an excellent illustration of the inadvisability at times of removing a foreign body from the brain, and also of the probable rebound of a ball from the inner surface of the skull:

Clarence P., aged fifteen years, of Victoria, B. C., first consulted me on April 9, 1903, at the instance of Dr. O. M. Jones, of Victoria, and of Sir Victor Horsley.

On October 24, 1902, he accidentally shot himself with a 22-calibre rifle. The bullet entered the right side of the forehead a half-inch above the eyebrow at the junction of the middle and external thirds. Dr. Jones saw him half an hour after the accident occurred, and found brain matter and blood oozing from the wound. The boy was collapsed and complained of numbness in the left leg and foot, but could move them. He was taken to a hospital, anæsthetized, the wound enlarged slightly, thoroughly cleansed, and an antiseptic dressing applied. The opening in the bone readily admitted the tip of the forefinger. Several small splinters of bone were removed, and from under the skin, about one inch *above* the opening in the bone, a sliver of the bullet was removed. The weight of a similar unused bullet is 29½ grains. The sliver weighed 5½ grains. The eight remaining pieces together, therefore, weigh 24 grains; the largest piece probably weighed about twenty grains (Fig. 1) Dr. Jones, wisely, did not probe for the bullet.

At the end of two or three days after the accident the left leg became entirely paralyzed. The first night he was extremely restless, with frequent involuntary movements of the right leg and arm, and on the day after the accident he had half a dozen very severe epileptiform convulsions, which ceased after a few doses of chloral and

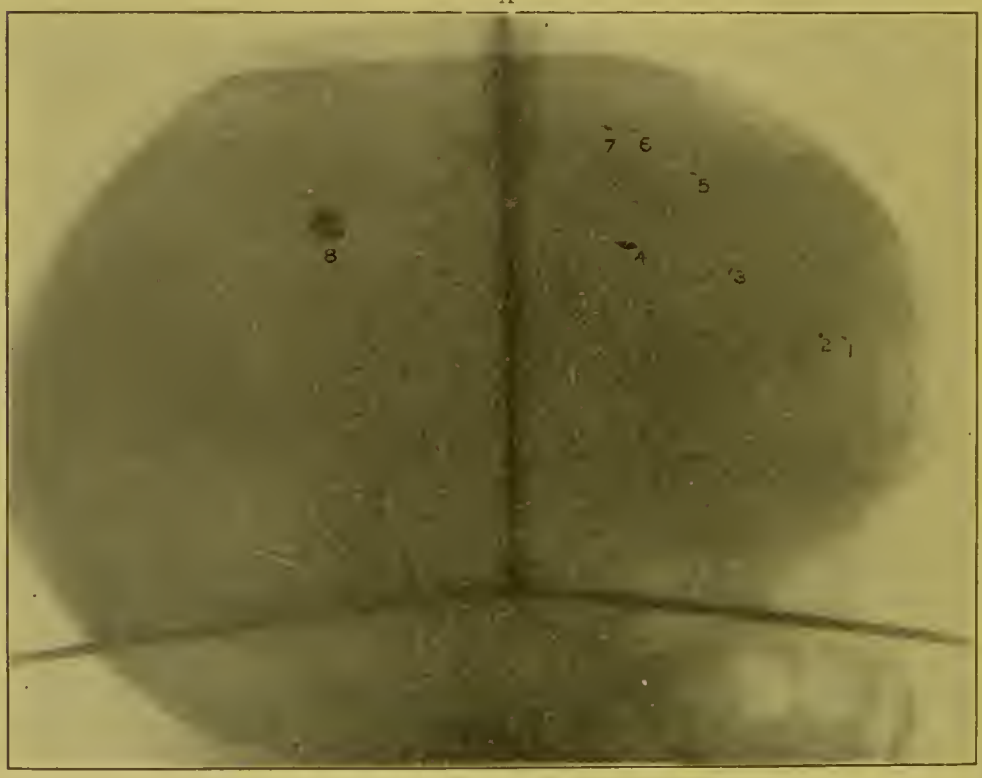
bromide and have not recurred. He gradually improved, never lost his intelligence, the paralysis diminished, and in the course of three months he was able to get about.

FIG. 1.

The upper figure is that of a similar bullet to the one causing the accident (weight 29½ grains); the lower figure is the sliver removed from under the skin above the wound of entrance (weight, 5½ grains). Both are natural size.

Status Præsens. April 9, 1903. There is a small scar just above the right eyebrow. No perceptible aperture in the bone can be felt. There is a little weakness still left in the left leg and foot, as shown by the fact that he balances himself unsteadily upon that foot, whereas

FIG. 2.



Skiagraph showing the eight fragments of the bullet.

upon the right one his balance is good. There is also some increased knee-jerk in the left leg, both with and without reinforcement.

The patient's friends in England had consulted both Sir Frederick

Treves and Sir Victor Horsley in reference to his treatment. A brief synopsis of their opinions is as follows: That the position of the retained bullet should be accurately determined; that the ball is now not likely to shift its position; that it is a possible source of future irritation which might result in traumatic epilepsy, and that the advisability of the removal of the ball would depend upon its location.

Dr. Sweet then made some skiagraphs of the head, of which one is presented in Fig. 2. By his method of localization he determined the following facts:

In the brain there are one principal fragment and seven other minute fragments of the bullet, the largest of the latter being about the size of a medium-sized pin's head. Two of these fragments are at the point of entrance. Five of them are scattered through the brain 2.5 cm. to 3 cm. *above* a line running from the wound of entrance to the present position of the ball. The position of each one of these fragments was precisely indicated on the scalp by Dr. Sweet.

After careful consideration of the present location of the bullet and of the boy's excellent recovery, I decided that it would be inadvisable to remove the ball. Of course, the removal of the smaller fragments was not even considered. The following were the reasons for my decision: The ball lay vertically 5 cm. below a point 2.2 cm. to the right of the middle line and 1.5 cm. back of the fissure of Rolando on a line parallel with the middle line (Fig. 3). Dr. Sweet marked not only the point on the top of the head corresponding vertically to the ball, but also a point above the ear which corresponded to it horizontally. This point was, of course, 5 cm. below the level of the top of the head, but on the curved surface of the scalp was 8.3 cm. from the middle line. It was 4.5 cm. back of the fissure of Rolando. In the horizontal plane from the surface of the head toward the middle line the ball lay at a distance of 6.3 cm. (Fig. 4). As it was very important that these two points corresponding horizontally and vertically to the position of the ball should be accurately and permanently marked, with a view to an accurate determination in the future whether any change in the position of the ball had taken place, they were marked in the following way: At the points which Dr. Sweet had marked upon the shaven scalp I injected a few drops of cocaine and then excised a small round piece of scalp, including the hair-follicles, so that there would be two small permanent bald spots at these points. As the boy was a very tall, well-developed lad, who had attained almost all of his growth, especially of the head, any later growth will not practically invalidate these measurements.

I wished then to determine the relation of the ball to the lateral ventricle, and for this purpose made a section of a brain hardened in formalin, at a point as nearly as possible corresponding to the figures given above. Comparing this with Dalton's vertical transverse sections through the brain, I found that it corresponded to Plate 15 of series

C quite exactly. Applying the foregoing measurements then to this figure, I determined that the position of the ball corresponded to the cross marked on a reproduction of this plate (Fig. 5). It will be observed that the ball lies far below the cortical leg centre and just above the lateral ventricle.

FIG. 3.

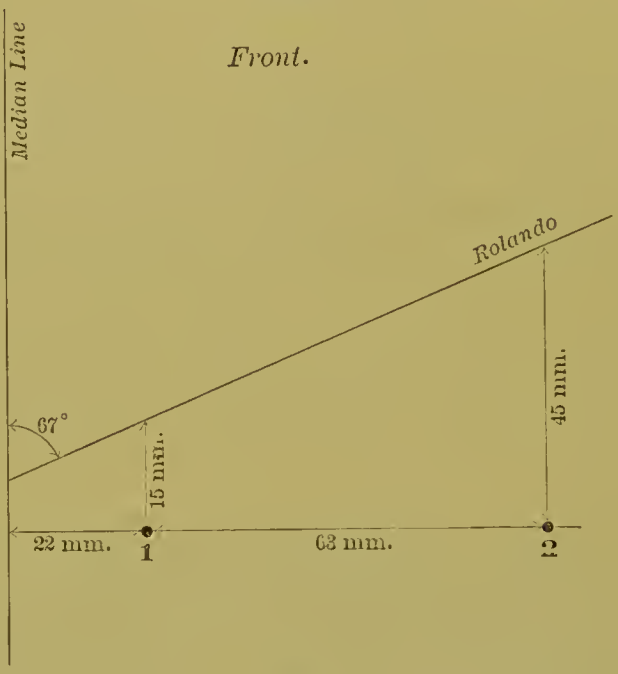
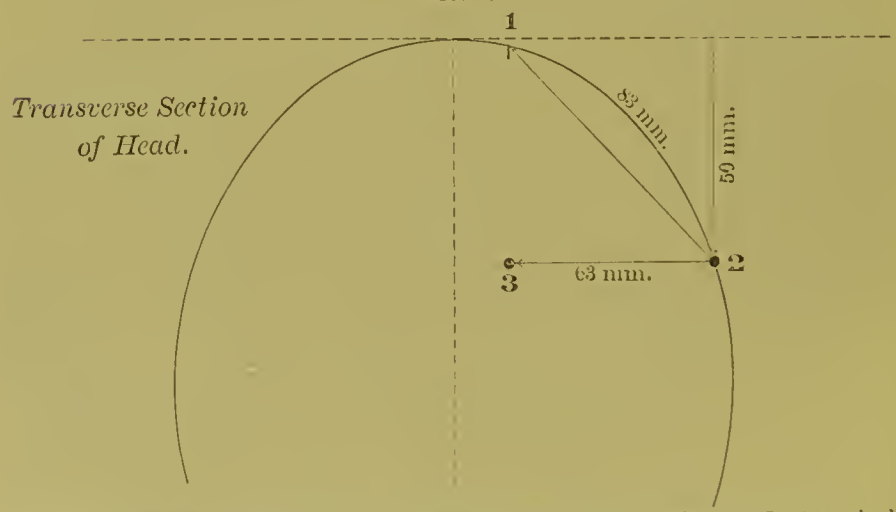


FIG. 4.

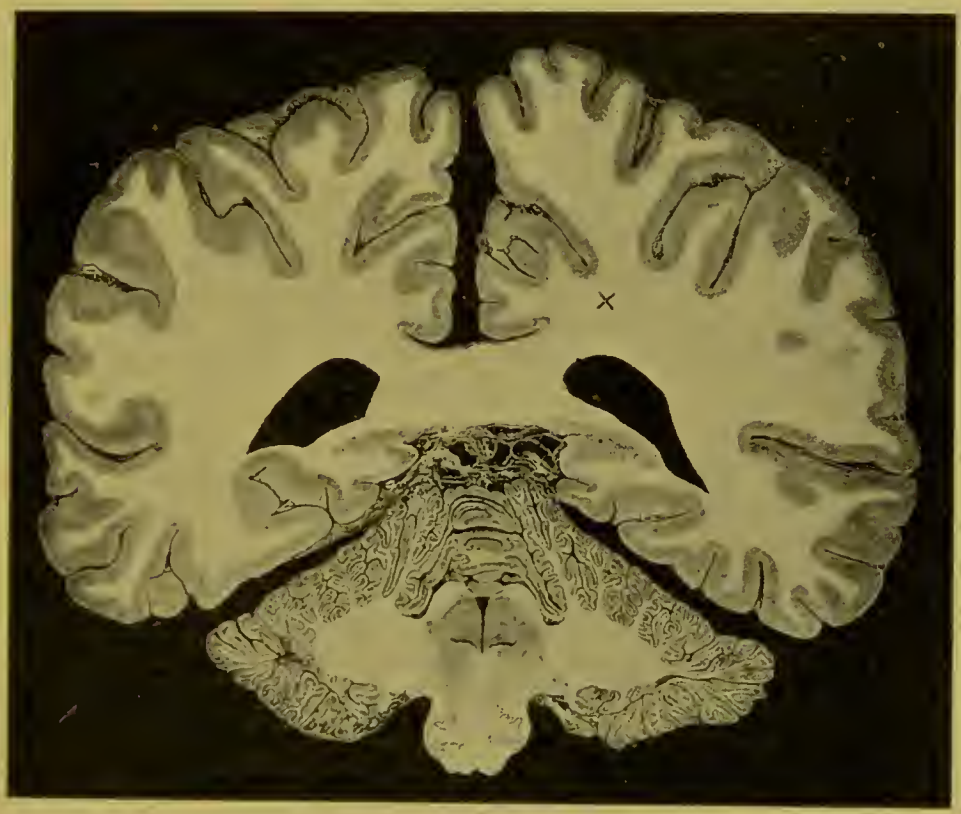


Diagrams to show the location of the largest fragment of the bullet. 1. Spot vertically over ball. 2. Spot horizontally corresponding to ball. 3. Site of ball.
[NOTE.—The measurement 83 mm. should be from the middle line to 2, and not from 1 to 2.]

The course of the bullet was evidently not in a straight line from the wound of entrance to its present position. This is shown by four facts: 1. The boy states that at the time of the accident he was not looking directly into the barrel of the rifle, in which case the antero-

posterior axis of the head would be nearly vertical, but that his head was only moderately flexed. 2. At the wound of entrance, as the ball penetrated the bone, a considerable sliver was taken off the ball by the *upper* edge of the bone and lay 2.5 cm. above this wound. 3. None of the fragments, except those at the point of entrance, lie in the direct line between the wound of entrance and the present position of the ball; they all lie *above* this line and at a considerable distance above it. 4. If the ball had gone in a straight line from the wound of entrance to its present position, it would not have touched the

FIG. 5.



X shows the present position of the largest fragment of the bullet.

cortical leg centre at all, though it is possible it might have divided some of the descending fibres from the leg centre. It seems, however, much more likely that the ball passed in a line from the wound of entrance to the point A, Fig. 2, and then was deflected to its present position, and in its course traversed the cortex. It would then have injured precisely the centre for the left leg.

I decided, therefore, that it would be inadvisable to remove the ball. In its present position it is doing no harm to the leg; his paralysis has steadily diminished, and in the course of a few months will probably

entirely disappear. Any attempt to remove the bullet would cause very much more injury to the brain than the bullet itself does in its present position. Accordingly I sent the patient home, with the following injunctions: First, as had been advised by Sir Victor Horsley, that he should not begin to study or do much reading until a year had elapsed from the time of the accident, and that he should then study under a tutor for a year, so as to postpone the excitement of a large school for two years from the date of the accident; second, that he should be allowed a greater degree of exercise as his leg improved; and, third, that if either of two symptoms arose he should immediately be brought back to me, viz., in case he developed persistent severe headache or any other symptoms which might suggest impending cerebral abscess; or if he should have a single epileptic attack, I should want to remove the ball immediately. The ball then would be doing more harm than the surgeon, whereas by any present interference the surgeon would do more harm than the ball.

It will be observed that at the time of the accident he had some severe epileptiform attacks, but has had none since. It is not impossible that he may never have any, and it seemed to me wiser to run the risk of a possible future epilepsy than a certain, immediate, and probably very serious damage to the brain by present surgical interference.

DR. SWEET'S REPORT ON THE METHOD OF LOCATING FOREIGN BODIES IN THE BRAIN AND ELSEWHERE BY THE X-RAYS.

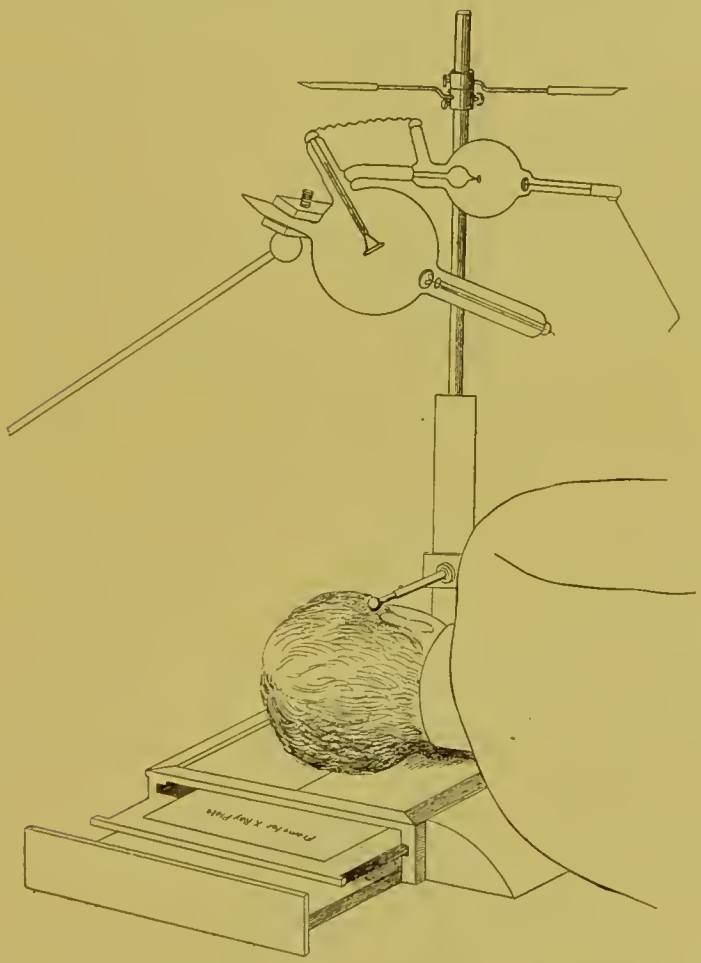
The methods employed in locating foreign bodies by the Roentgen rays are all based upon the triangulation of the planes of shadow of the body, with the X-ray tube in two different positions. Measurements of the distance of the crossing of these planes from one or more points marked upon the skin give the exact situation of the foreign substance.

Accuracy of localization depends upon a knowledge of the position of the tube at the two exposures, its distance from the photographic plate, and upon the proper marking of one or more spots upon the skin by opaque substances that will cast shadows upon the plate. A special form of apparatus achieves these results in the most satisfactory manner.

The apparatus for locating foreign bodies is similar in principle to that employed so successfully during the past few years in determining the situation of pieces of metal in the eyeball. I have recently designed a new form of localizer, which is shown in the accompanying illustrations. It consists of a firm base, the top of which is covered with sheepskin, and is crossed by two steel wires at right angles to each other. A sliding

drawer on one side permits the changing of the photographic plate without disturbing the position of the patient. A hollow upright bar attached to one side of the base supports three movable rods. One rod has its extremity pointed, over which slips an indicating ball. The other rods are employed to indicate the situation of the tube at the two exposures. The centre of the indicating ball is directly above the

FIG. 6.



Side view of the indicating apparatus, showing position of tube and indicator, and also receptacle for the photographic plates.

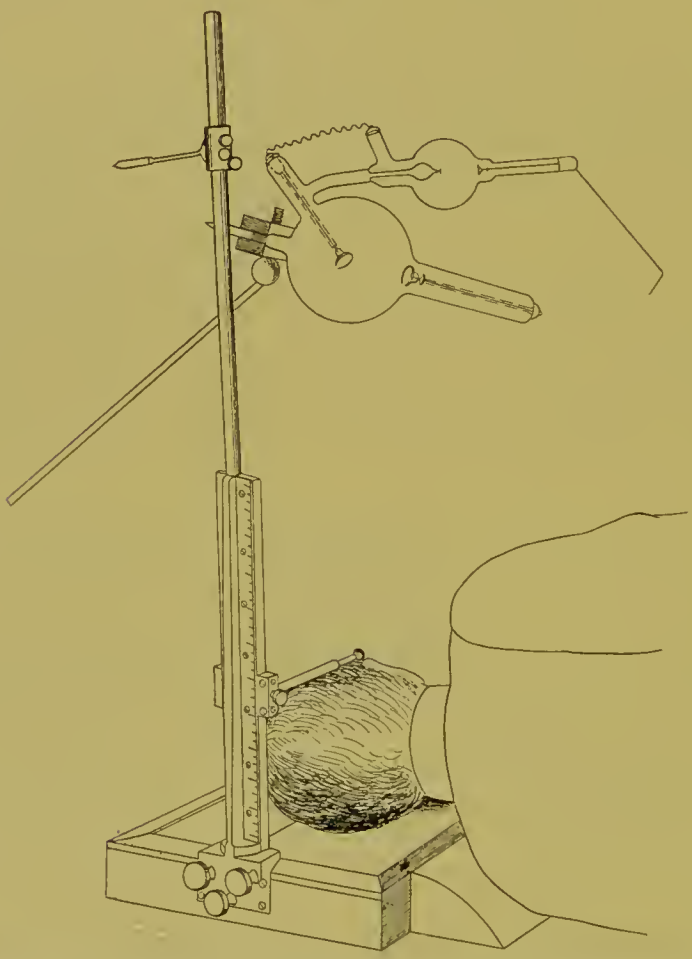
crossing of the two wires on the base, and its height is shown by a scale upon the upright bar.

The head or other portion of the body containing the foreign substance to be located rests upon the top of the base portion, the cross-wires, previously inked, leaving a mark upon the skin. The indicating rod is lowered until the ball rests upon the skin, and this spot is also indicated with ink. The distance of the ball above the cross-wires is read from the graduated scale.

The X-ray tube is placed from eighteen to twenty inches above the plate, and the distance of the anode of the tube carefully measured. One exposure is then made with the tube directly above or to one side of the indicating ball, and a second plate made with the tube from three to four inches from the first position.

After development the plates show the shadows cast by the cross-wires, the indicating ball, and the foreign body. The distance of the foreign substance from the marks upon the skin of the patient may be

FIG. 7.

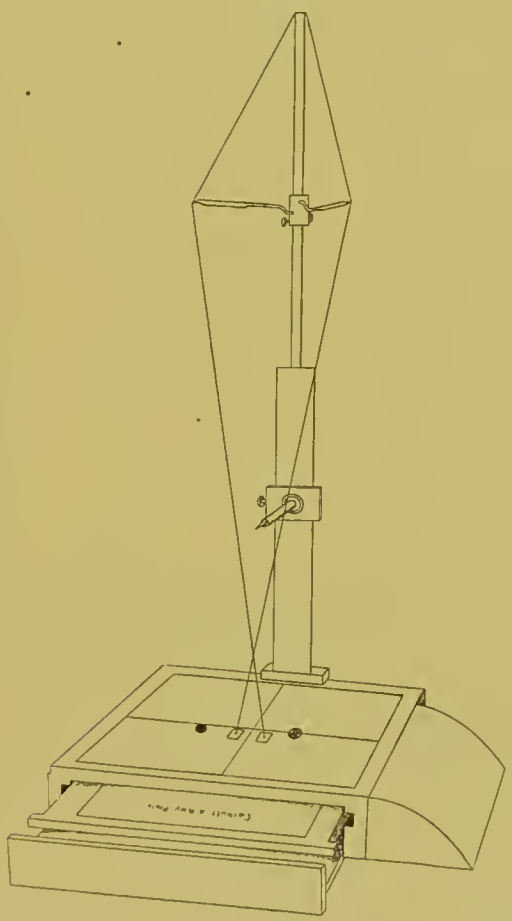


Side view of apparatus, showing indicating rod and graduated upright.

determined by plotting upon a flat surface the position of the tube, indicating ball, and the cross-wires at the two exposures, and finding the crossing of the planes of shadow of the foreign body. This method is the one employed in eye-work, and is equally accurate in dealing with other portions of the body, although somewhat more complicated. For this reason I have employed threads to indicate the crossing of the planes of shadow in the new localizing apparatus—a method which has been developed by Mackensie Davidson, of London.

The method of employing the indicating apparatus is as follows: A tracing of the two negatives is made upon a transparent sheet of celluloid, with the point of crossing of the wires corresponding. This celluloid sheet is placed upon the top of the base of the apparatus with the tracing of the shadow of the cross-wires directly above the point of crossing of the wires. The indicating rod is moved to the height it occupied at the time the exposures were made. A thread is now passed from the spot on the celluloid representing the shadow

FIG. 8.



Planes of shadow represented by threads, the point of crossing of which indicates the situation of the bullet.

of the indicating ball at one exposure, touches the point of the indicating rod representing the centre of the ball, and is continued the exact distance that the tube was away from the plate when the radiograph was made. A second thread passes in the same manner from the shadow of the indicating ball at the second exposure. The threads are kept taut by lead weights in the hollow upright tube. These two threads accurately indicate the lines of shadow of the indicating ball at the two exposures, and also the position of the tube. If the ends of the

threads resting upon the shadows of the indicating ball are now moved to the spots on the transparent celluloid representing the shadows made by the bullet, their crossing will show its position in the tissues in relation to the indicating ball and cross-wires. The distance of this point of crossing from the indicating ball gives the location of the body in the tissues as measured from the spot on the skin at which the ball rested when the two plates were made. The situation of the bullet may also be measured from the cross-wires. The depth of the body will determine which of the two points is to be chosen in plotting the position of the body for operation. The location of each fragment of the bullet is similarly determined.

The apparatus was made for me by Queen & Co., of Philadelphia.